Connecting all the pieces in the puzzle

Ecosystems

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WHEN YOU walk outside in the morning, you expect to breathe clean air. You'd think it odd if you couldn't find fresh fruits and vegetables in the grocery store. And when you turn the tap on in your kitchen, you expect your glass will fill with water that's safe to drink.

The air we breathe, the food we eat and the water we drink comes to us courtesy of nature's ecosystems.

Just to review, an ecosystem is a community of plants and animals interacting with one another and with their physical environment. Ecosystems also include the soil, water and nutrients that support the organisms that live within the ecosystem. These organisms range from large animals and plants to microscopic bacteria.

Ecosystem services

In her 1997 publication, *Nature Services: Societal Dependence on Natural Ecosystems*, Gretchen Daily defined the "services" provided by ecosystems as "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life" by producing, directly or indirectly, goods and life-support services that benefit people.

Examples of the services ecosystems provide include: (1) clean air; (2) water purification and storage; (3) livable climates; (4) pollination of crops and other vegetation; (5) soil generation and preservation of its fertility; (6) control of agricultural pests and disease-carrying organisms; (7) genetic resources and maintenance of biodiversity; (8) mitigation of drought and floods; (9) erosion control; (10) cycling of nutrients, such as nitrogen and carbon; (11) detoxification and decomposition of wastes; and (12) cultural, spiritual and intellectual experiences.

Unfortunately, the ecosystems that have provided the services essential to sustain humanity since the beginning of time are becoming more and more compromised every day. Even though they're fundamental to life as we know it, people often take ecosystem services for granted until their disruption or loss highlights their importance. It then becomes clear how costly and how hard, or in some cases impossible, it is to replace these services with human-engineered alternatives.

Ecosystems worldwide are suffering, most likely because people don't realize how valuable ecosystems are to them. Also, there are practically no social and economic mechanisms to encourage people to invest in maintaining them.

Unless people start to consider the true impacts of their actions on

Ecosystems are characterized by the interactions between communities of plants, animals and the environments in which they live.

Healthy ecosystems are able to support a healthy diversity of wildlife.

ecosystems, and make wiser choices to better maintain and restore the health of ecosystems, the services nature provides us will be impaired or destroyed.

Placing precise monetary values on various ecosystem services is difficult, but in some cases the estimates of the costs involved have been calculated. The following are some examples from the Ecological Society of America:

- Much of the Mississippi River Valley's natural flood-protection services were destroyed when wetlands adjacent to the valley were drained and channels were altered. As a result, floods in 1993 resulted in property damages estimated at $12 billion. Part of the reason for the staggering figure is the inability of the valley's depleted ecosystem to lessen the impacts of the high volumes of water.
- Before it was overwhelmed by agricultural and sewage runoff, the watershed of the Catskill Mountains provided New York City with water ranked among the best in the nation. When the water fell below quality standards, the city investigated what it would cost to install an artificial filtration plant. The estimated price for a new facility was $6 billion to $8 billion, plus an annual operating cost of $300 million. That's a high price to pay for clean water that was once free. New York City decided to invest a fraction of that cost, $660 million, to restore the natural capital it had in the Catskill's watershed.
- More than 100,000 animal species, including bats, bees, flies, moths, beetles, birds and butterflies, provide free pollination services. One third of human food comes from plants pollinated by wild pollinators. Pollinators play a key role in the production of more than 150 food crops. In the United States alone, the value of pollination services from wild pollinators is estimated at $4 billion to $6 billion a year.

• Eighty percent of the world's population relies on natural medicinal products. Of the top 150 prescription drugs in the United States, 118 originate from natural sources. Seventy four percent of these 118 drugs originate from plants, 18 percent from fungi, five percent from bacteria and three percent from a snake. Nine of the top 10 drugs in the U.S. originate from natural plant products.

> "Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land."
>
> — Luna Leopold —

Clean water

In Utah, the nation's second-driest state, water purification is an especially important ecosystem service.

Wetlands, forests and riparian (streamside) zones provide clean drinking water and water suitable for industrial uses, recreation and wildlife habitat. As water moves through these ecosystems, pollutants such as metals, viruses, oils, excess nutrients and sediment are filtered out and absorbed by soil particles and living organisms. Microorganisms (bacteria and other microbes), the natural chemical engineers of ecosystems, utilize or break down nutrients, metals and other chemical contaminants in the water as it passes through the soil. These ecosystems cleanse many types of pollutants for us:

• Nitrogen and phosphorus, nutrients essential for life, can become serious pollutants when they occur in excessive amounts. Excess nitrogen and phosphorus enter waterways from sources such as manure, fertilizers and septic tanks. They can cause blooms of algae that decrease oxygen levels in water, resulting in the death of fish and other serious problems. Ecosystems remove nutrients through direct uptake by plants, algae, bacteria, insects and fish, or by absorbing nutrients into the soil. Incredibly, riparian areas reduce the nitrogen concentration in water runoff and floodwater by up to 90 percent and can reduce phosphorous by as much as 50 percent.

• Certain pesticides and herbicides can kill aquatic organisms and cause developmental abnormalities and disease in animals and people. These pollutants often enter rivers through runoff from roads, agricultural areas and golf courses. Pesticides and herbicides are very expen-

Winter snowfall in the mountains creates a reservoir of fresh water that flows to lower elevations throughout the year.

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Even the driest parts of Utah support healthy communities of plants and animals adapted to those environments.

sive to remove if they enter the drinking water supply. In natural ecosystems, many bacteria make a living degrading organic chemicals and many are important in breaking down pesticides and herbicides.

- Heavy metals such as mercury enter aquatic systems from a variety of sources. They can disrupt aquatic systems, harming aquatic organisms and making water unsafe to drink. Fish in affected waters also can become unsafe to eat. Wetlands process and remove 20 to 60 percent of these run-off metals when they enter the system in runoff.
- Excessive sedimentation occurs as soil is eroded and washed into waterways or blown in from exposed earth. Construction, road building, logging and agricultural activities can cause this to occur. Large amounts of sediment can reduce a waterway's ability to control floods by exhausting its capacity to store extra sediments that come with flooding. Excess sedimentation also clouds streams, harming fish and underwater vegetation. Other pollutants, such as fertilizers and pesticides, also can be washed into waterways with sediments. Wetlands, however, can trap 80 to 90 percent of sediments that come through runoff.

Keeping ecosystems healthy is the key to maintaining the water purification and other natural services ecosystems provide. We may not be able to survive without these services.

YOU MAY BORROW the following educational trunks from Project WILD to use with your students: *Understanding the Work of Nature, Appreciating Nature's Services,* and *Conserving the Diversity of Life.* Each trunk contains an easy-to-follow activity guide with instructions and background information plus maps, posters, videos, and CD-ROMs and other supplemental materials. Because of their large size, these trunks cannot be shipped. To reserve a trunk, call Diana Vos at (801) 538-4719.

Getting WILD! Utah's WILD Notebook is produced by Utah's Project WILD program. WILD workshops, offered by the Utah Division of Wildlife Resources, provide teachers and other educators with opportunities for professional development and a wealth of wildlife education activities and materials for helping students learn about wildlife and its conservation. For a current listing of Project WILD educator workshops, visit the Project WILD Web site at *wildlife.utah.gov/projectwild* or e-mail *DianaVos@utah.gov.*

Information: Read more on the Web about ecosystem services, threats to ecosystems, solutions, details about things you can do to make a difference and educational resources.

- *actionbioscience.org/environment/esa.html*
- *earthsky.com/shows/earthcare/shows.php?s=s&h=Ecosystem%20Services*
- *esa.org/ecoservices/wate/body.wate.intr.html* (see all links)
- *sciencenetlinks.com/lessons.cfm?DocID=275* (many excellent educational links)
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